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Engel et al.

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[54] **METHOD OF PRODUCING A FRAGMENTATION JACKET**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[5] **B21K 21/06**

[52] **U.S. Cl.** **29/1.21**; 29/1.23; 71/348; 102/493

[58] **Field of Search** 29/1.1, 1.11, 1.2, 1.21, 29/1.22, 1.23; 72/348; 102/493

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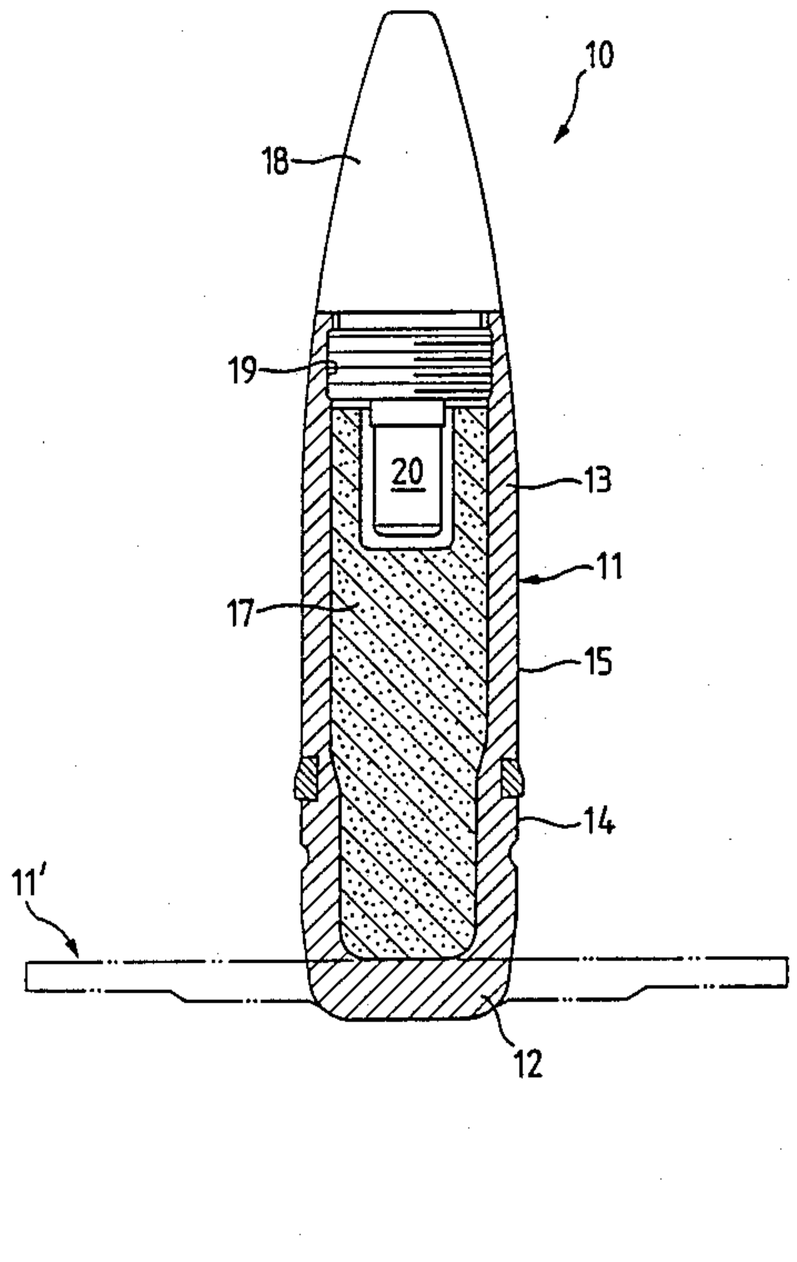
Attorney, Agent, or Firm—Sandler, Greenblum & Bernstein

[57] **ABSTRACT**

The fragmentation jacket of a projectile or shell should be prefragmentized in the simplest possible manner by means of reference fracture locations provided at the inner side or interior surface of the fragmentation jacket. For this purpose, the reference fracture locations are impressed into a disk, for example, by stamping. Subsequently, the thus formed disk is shaped by deep drawing to form a fragmentation jacket such that the reference fracture locations formed by grooves are located at the inner side or interior surface of a cup-shaped fragmentation jacket. This cup-shaped fragmentation jacket is filled with an explosive charge which is detonated by a base fuze or by a tip or point fuze.

12 Claims, 4 Drawing Sheets



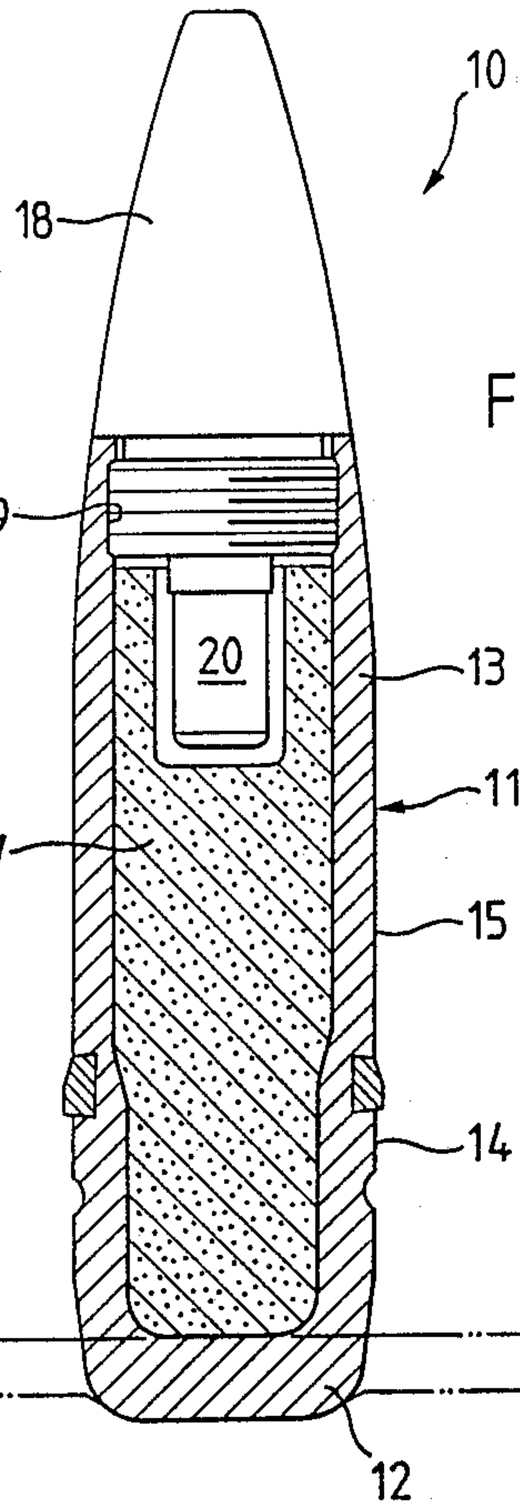


FIG. 1

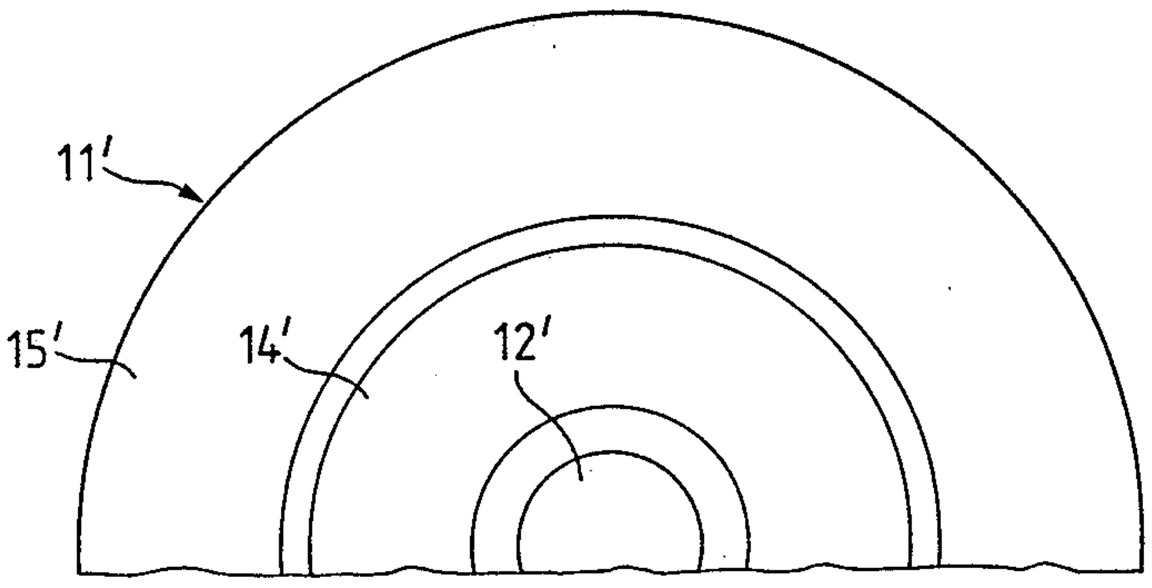


FIG. 3

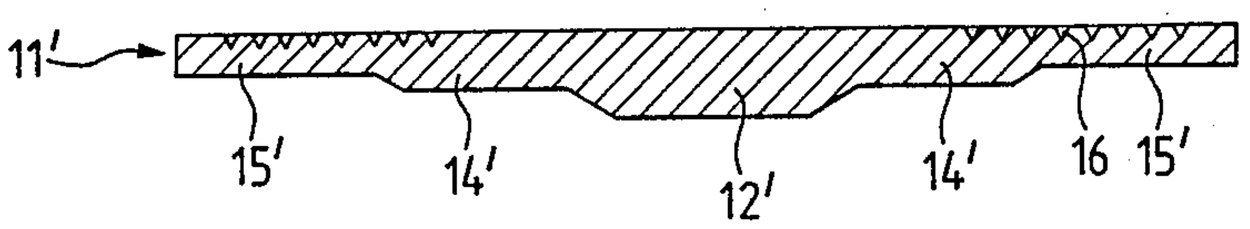


FIG. 2

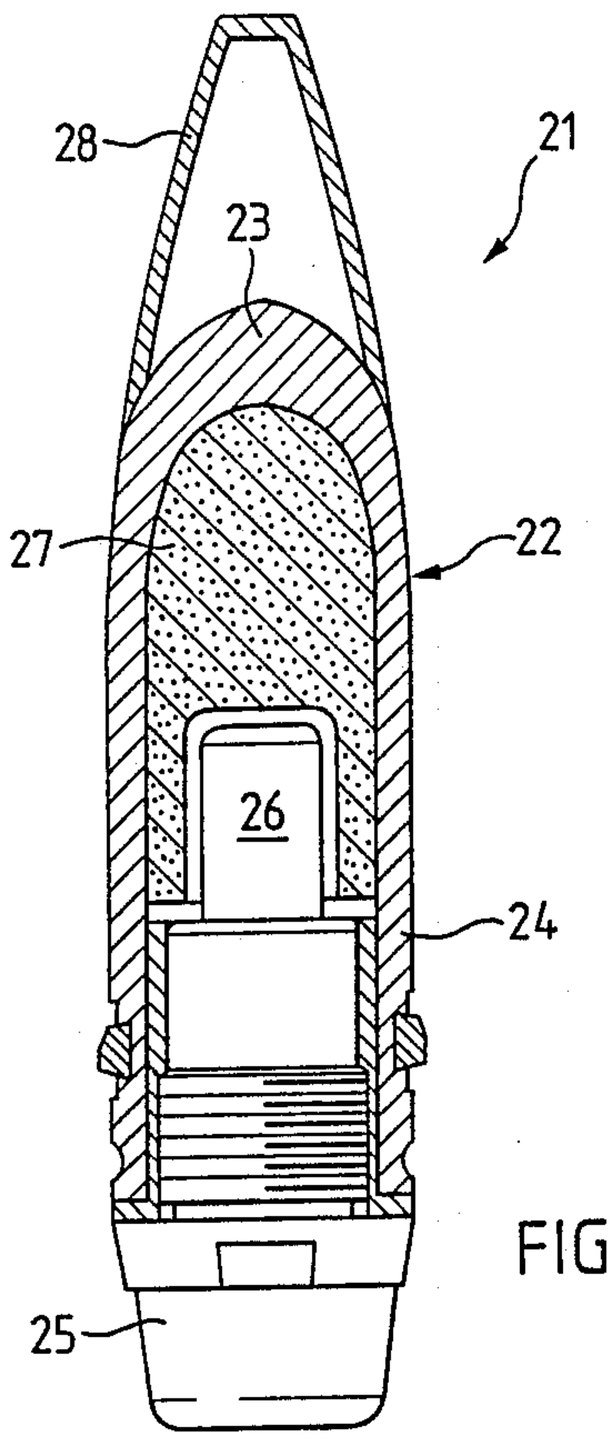


FIG. 4

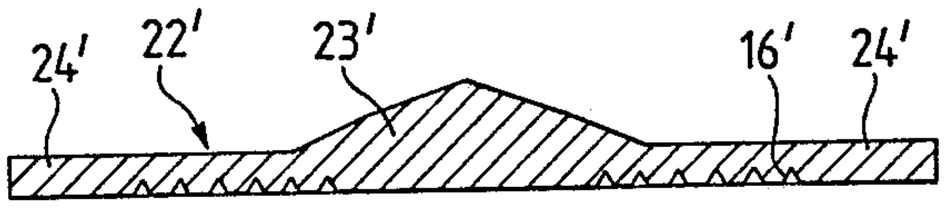


FIG. 5

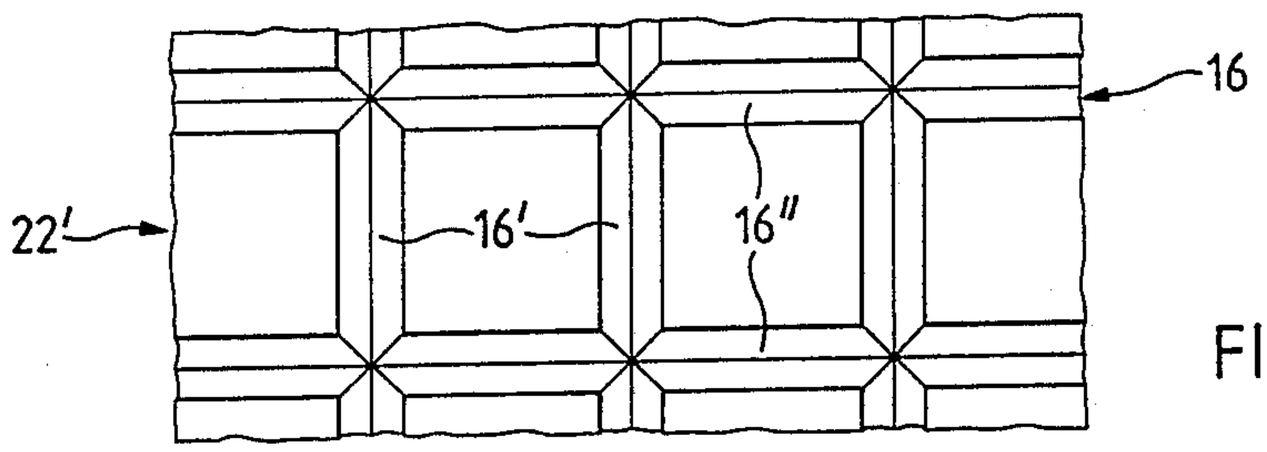


FIG. 7

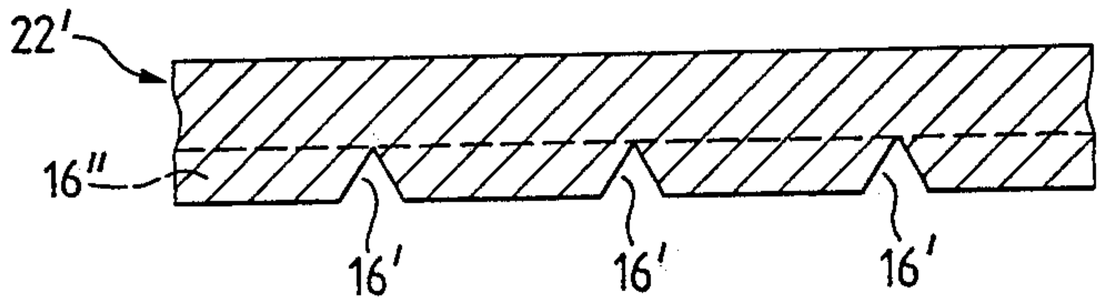


FIG. 6

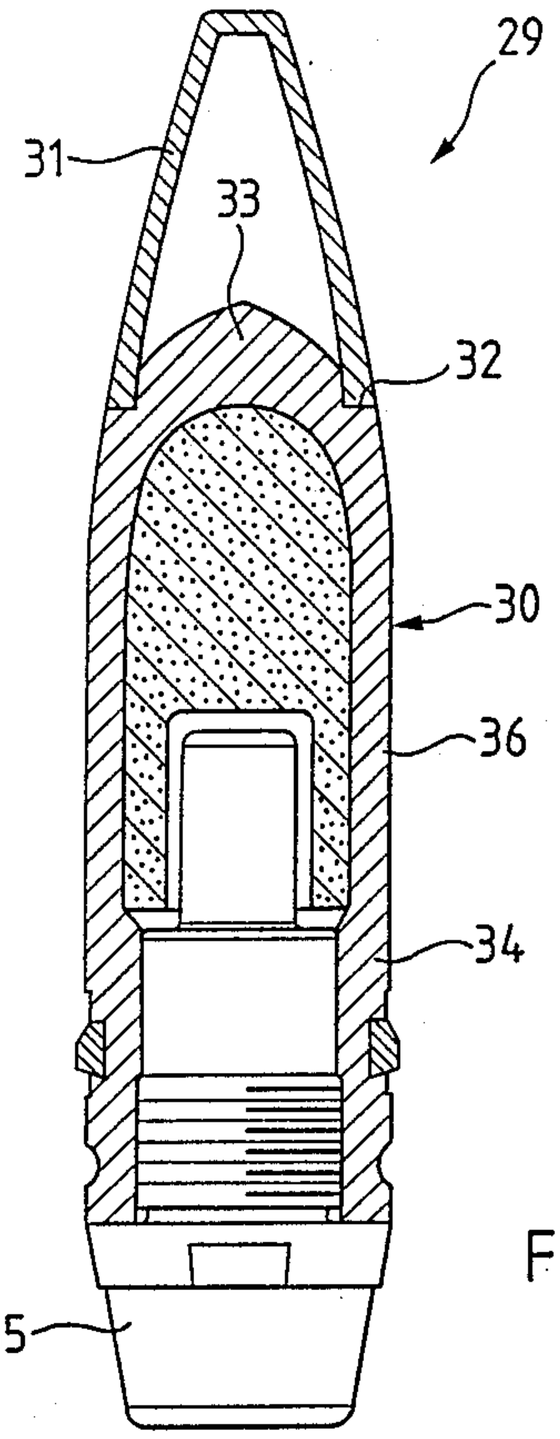


FIG. 8

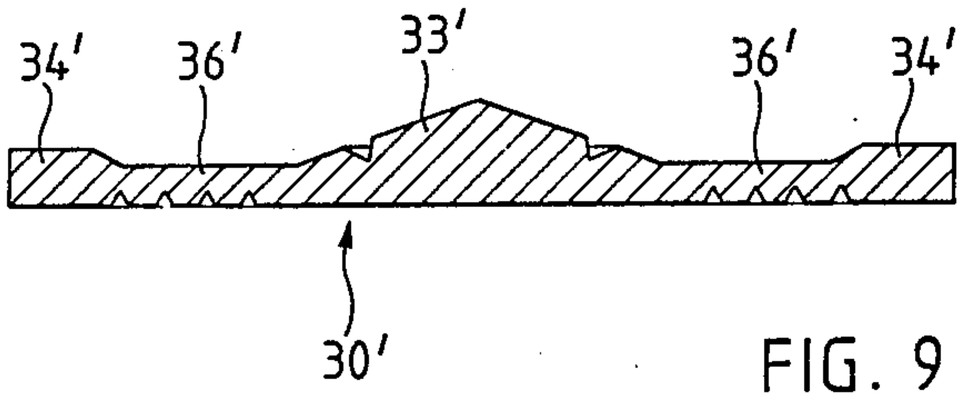


FIG. 9

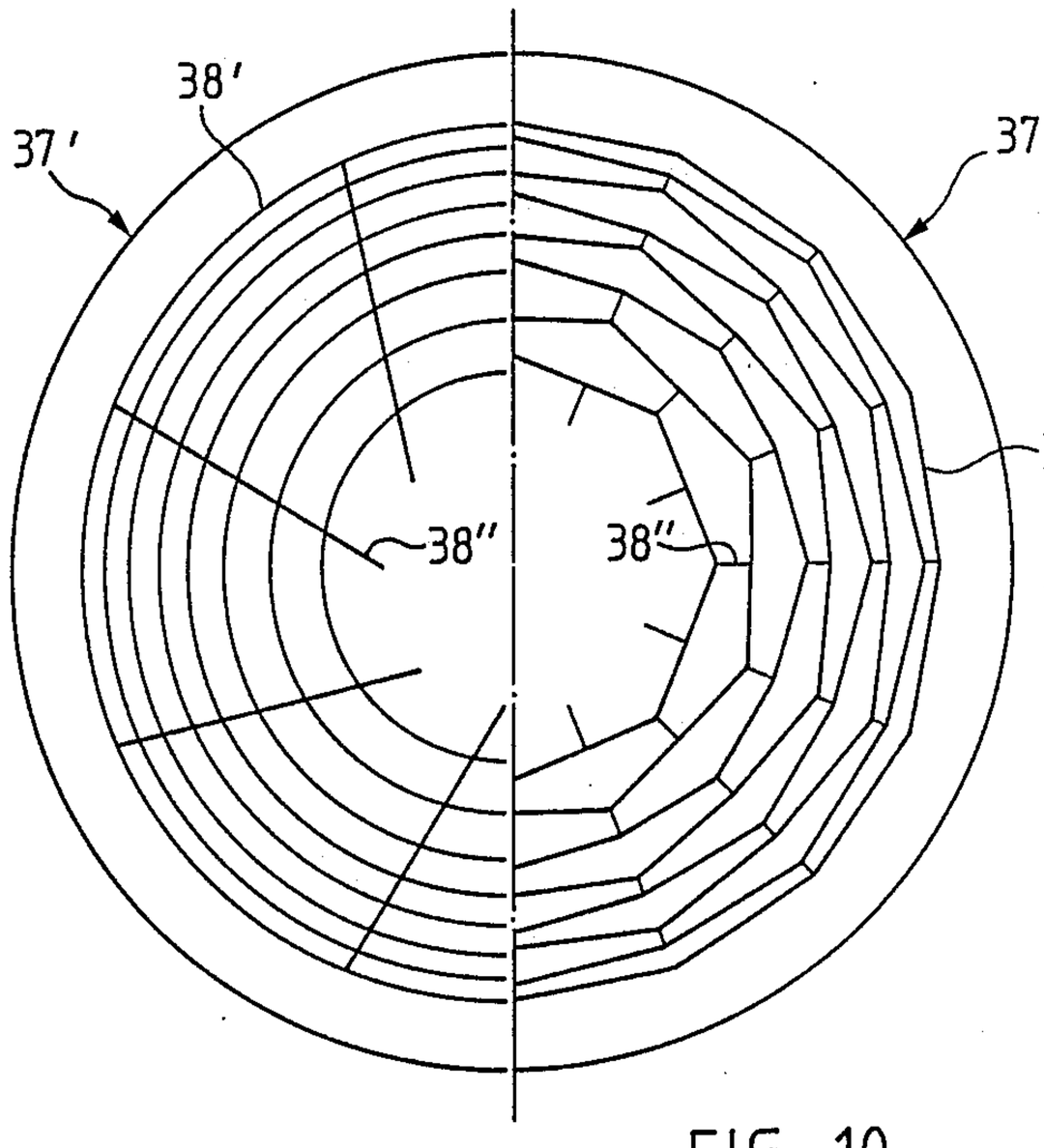


FIG. 10

METHOD OF PRODUCING A FRAGMENTATION JACKET

BACKGROUND OF THE INVENTION

The present invention broadly relates to ammunition rounds for weaponry and pertains, more specifically, to a new and improved method of producing a fragmentation or splintering jacket for a projectile or shell. In the interior of the fragmentation or splintering jacket there is located an explosive charge which is detonated by a fuze or detonator.

In its more particular aspects the present invention specifically relates to a new and improved method of producing a fragmentation or splintering jacket for a projectile or shell and which method encompasses producing a blank in the form of a disk, impressing into the disk reference fracture locations in the form of grooves and then subjecting the disk to a shaping operation in order to form the fragmentation or splintering jacket from the disk.

A warhead produced according to a known method of manufacturing splintering jackets is disclosed, for example, in German Petty Patent No. G 8,427,780.7, published May 15, 1985. A warhead housing serves to receive a hollow charge. A detonator or fuze is fastened to the warhead housing which is cup-shaped and fabricated by a shaping process, for instance deep drawing, from a metallic blank in the form of a round disk. A wire netting is rolled into the disk. This known method of fabricating a warhead of the fragmentation type is complicated and impractical for mass production purposes. Furthermore, the wire netting does not provide any particular advantages.

SUMMARY OF THE INVENTION

Therefore, with the foregoing in mind, it is a primary object of the present invention to provide a new and improved method of producing a fragmentation or splintering jacket and which method is not afflicted with the drawbacks and limitations of the prior art methods heretofore discussed.

Another significant object of the present invention is directed to providing a new and improved method of producing a fragmentation or splintering jacket and which method is inherently simple, and especially suitable for mass production of such fragmentation or splintering jackets.

Now in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the method of producing a fragmentation or splintering jacket of the present development is manifested, among other things, by the features that the disk is produced to comprise portions having different thicknesses and defining a predeterminate configuration of the fragmentation or splintering jacket to be produced, prior to shaping the fragmentation or splintering jacket from such disk. BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein throughout the various figures of the drawings, there have been generally used the same reference characters to denote the same or analogous components and wherein:

FIG. **1** shows a longitudinal sectional view through a projectile or shell comprising a tip or point or nose fuze or detonator and a fragmentation or splintering jacket produced according to a first exemplary embodiment of the inventive method;

FIG. **2** shows a cross-section through a disk from which the fragmentation or splintering jacket depicted in FIG. **1** is fabricated;

FIG. **3** is a fragmentary top plan view of the disk depicted in FIG. **2**;

FIG. **4** shows a longitudinal sectional view through a projectile or shell comprising a base fuze or detonator and a fragmentation or splintering jacket produced according to a second exemplary embodiment of the inventive method;

FIG. **5** shows a cross-section through a disk from which the fragmentation or splintering jacket depicted in FIG. **4** is fabricated;

FIG. **6** shows, on an enlarged scale in relation to the illustration of FIG. **5**, a detail of the cross-section through the disk depicted in FIG. **5**;

FIG. **7** shows a top plan view of the detail illustrated in FIG. **6**;

FIG. **8** shows a longitudinal sectional view through a modified projectile or shell comprising a base fuze or detonator and a fragmentation or splintering jacket produced according to the second exemplary embodiment of the inventive method;

FIG. **9** shows a cross-section through a disk from which the fragmentation or splintering jacket depicted in FIG. **8** is fabricated; and

FIG. **10** shows, in a top plan view of a disk, different configurations of grooves defining reference fracture locations.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, it is to be understood that to simplify the showing thereof, only enough of the projectile or shell has been illustrated therein as is needed to enable one skilled in the art to readily understand the underlying principles and concepts of this invention. Turning now specifically to FIG. **1** of the drawings, the steps of the inventive method are hereinafter described in connection with a projectile or shell **10** produced according to the inventive method and illustrated therein by way of example and not limitation.

The projectile or shell **10** comprises a cup-shaped fragmentation or splintering jacket **11**. This fragmentation or splintering jacket **11** possesses a base or bottom **12** which is arranged at the rear or tail end of a sleeve-shaped projectile body **13**. The rear or tail part or portion **14** of the sleeve-shaped projectile body **13** possesses a smaller internal or inner diameter than the front or head part or portion **15**. In other words, the wall of the rear or tail part or portion **14** is thicker than the wall of the front or head part or portion **15** the base or bottom **12** is thicker than the wall of the rear or tail part or portion **14** of the sleeve-shaped projectile body **13**.

The fragmentation or splintering jacket **11** is fabricated from a disk **11'** which is illustrated in FIGS. **2** and **3** and indicated by dash-dotted lines in FIG. **1**. In correspondence with the shape or configuration of the fragmentation or splintering jacket **11** to be produced, the disk **11'** comprises an inner part or portion **12'** having a thickness corresponding to the thickness of the base or bottom **12**, an intermediate annular part or portion **14'** having a thickness corresponding to the thickness of the

rear or tail part or portion **14** of the sleeve-shaped projectile body **13**, and an outer annular part or portion **15'** having a thickness corresponding to the thickness of the front or head part or portion **15** of the sleeve-shaped projectile body **13**. In this manner, the inner part or portion **12'** is thicker than the intermediate annular part or portion **14'** and, in turn, the latter is thicker than the outer annular part or portion **15'**.

One side of the disk **11'** depicted in FIG. **2** is provided with grooves **16**. The form or shape of these grooves **16** is shown on an enlarged scale in FIGS. **6** and **7**. As depicted in FIG. **6**, these grooves possess a substantially triangular or V-shaped cross-section. According to the top plan view of FIG. **7**, there are provided lengthwise, i.e. annular grooves **16'** and transverse, i.e. radial grooves **16''**. The upper side of the disk **11'** as depicted in FIG. **2** and comprising the grooves **16** constitutes the inner side or surface of the fragmentation or splintering jacket **11** after subjecting the disk **11'** to a shaping operation in order to form the fragmentation or splintering jacket **11**. Such shaping operation of the disk **11'** is effected in conventional and known manner, particularly by, for example, deep drawing.

The projectile or shell **10** comprises a bursting or explosive charge **17** within the fragmentation or splintering jacket **11**. This bursting or explosive charge **17** is detonated by means of a suitable tip or point or nose fuze **18** which is screwed into or threadably connected to an internal thread or tap **19** of the fragmentation or splintering jacket **11**. A booster or booster charge **20** is located at the rear or tail end of the point or nose fuze **18** and projects into the interior of the bursting or explosive charge **17**.

In accordance with FIG. **4** a projectile or shell **21** likewise comprises a cup-shaped fragmentation or splintering jacket **22**. This fragmentation or splintering jacket **22** possesses a tip or nose **23** which closes a sleeve-shaped projectile body **24** at a front or head portion thereof. This cup-shaped fragmentation or splintering jacket **22** is thicker at the tip or nose **23** than at the rear or tail end thereof. Furthermore, this fragmentation or splintering jacket **22** is likewise fabricated from a disk **22'** which has a central part or portion **23'** which forms the tip or nose **23** and has a correspondingly greater thickness. This disk **22'** comprises at its lower side, as can be seen in FIG. **5**, lengthwise, i.e. annular grooves **16'** and transverse, i.e. radial grooves **16''** as described hereinbefore and depicted in FIGS. **6** and **7**. A suitable base fuze or detonator **25**, as shown in FIG. **4**, is located at the rear or tail end and screwed into or threadably connected to the cup-shaped fragmentation or splintering jacket **22**. This base fuze or detonator **25** comprises a booster or booster charge **26** which projects into the interior of a bursting or explosive charge **27** located within the cup-shaped fragmentation or splintering jacket **22**.

Contrary to the first exemplary embodiment of the inventive method of producing the sleeve-shaped projectile body **13** illustrated in FIG. **1**, the sleeve-shaped projectile body **24** produced according to the second exemplary embodiment of the inventive method, possesses substantially the same thickness in the front or head portion as well as in the rear or tail portion. Accordingly, the disk **22'** is only subdivided into a relatively thicker central part or portion **23'** and a relatively thinner outer annular part or portion **24'**. In this second embodiment, the projectile or shell **21** containing the base fuze or detonator **25** instead of the point or nose fuze or detonator **18**, requires a ballistic hood or cap **28**. As depicted in FIG. **4**, this ballistic hood or cap **28** is simply placed upon or fitted to the smooth surface of the cup-shaped fragmentation or splintering jacket **22**.

According to FIGS. **8** and **9** a projectile or shell **29** comprises a cup-shaped fragmentation or splintering jacket **30**. Contrary to the cup-shaped fragmentation or splintering jacket **22** shown in FIG. **4**, a circumferential groove **32** is arranged at the cup-shaped fragmentation or splintering jacket **30** for mounting a ballistic hood or cap **31**. The cup-shaped fragmentation or splintering jacket **30** comprises not only a comparatively substantially thicker tip or nose **33**, but also a comparatively thicker sleeve-like rear or tail portion or section **34**. Therebetween, there is located a relatively thinner intermediate portion or section **36**. Accordingly, a disk **30'** possesses a different cross-section as compared to the disks **11'** and **22'**. This disk **30'** is subdivided into a relatively thicker inner part or portion **33'**, a relatively thinner intermediate annular part or portion **36'** and a relatively thicker outer annular part or portion **34'**.

A disk **37'** as depicted in FIG. **10**, shows different patterns or configurations of grooves **38'** and **38''** on the two sides of a central, dash-dotted dividing line. The patterns or configurations of these grooves **38'** and **38''** are selected such that regular hexagons or quadrangles are respectively formed when the disk **37'** is shaped into a cup-shaped fragmentation or splintering jacket.

The grooves **38''** which may extend in substantially radial direction or at a preselected inclination thereto, are preferably formed or impressed into the disk **37'** to have a smaller depth than the substantially concentric annular grooves **38'**. This has the advantage that there is obtained, by virtue of the different impressing depths of the grooves **38'** and **38''**, a uniform disintegration of the cup-shaped fragmentation or splintering jacket into fragments or splinters of the desired size.

While there are shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims. ACCORDINGLY,

What I claim is:

1. A method of producing a fragmentation jacket for a projectile comprising within the fragmentation jacket an explosive charge which is detonated by a fuze, comprising the steps of:

producing a blank in the form of a disk;

impressing into the disk impressions defining reference fracture locations in the form of grooves;

said step of impressing into the disk impressions defining reference fracture locations in the form of grooves entailing the step of impressing into at least one side of the disk substantially concentric annular grooves and substantially radial grooves having a smaller preselected depth than that of said substantially concentric annular grooves;

subjecting the grooves-containing disk to a shaping operation, thereby forming a fragmentation jacket having a predeterminate configuration;

said step of producing said blank in the form of a disk entailing the step of producing a disk comprising a central portion, an intermediate annular portion and an outer annular portion having a different thicknesses relative to each other;

during said step of impressing into said disk said substantially concentric annular grooves and said sub-

stantially radial grooves having said smaller preselected depth than said substantially concentric annular grooves, impressing said substantially concentric annular grooves and said substantially radial grooves, at least into said intermediate annular portion of said disk; and

said step of subjecting the grooves-containing disk to the shaping operation forming said fragmentation jacket entailing the step of forming a substantially cup-shaped fragmentation jacket having opposite end portions and a substantially cylindrical intermediate portion of different wall thicknesses which correspond to said different thicknesses of the portions of said disk and which define said predeterminate configuration of said fragmentation jacket and thereby forming, at least in an inner surface and at least in said substantially cylindrical intermediate portion, substantially lengthwise grooves corresponding to said substantially radial grooves of said disk and substantially concentric circumferential grooves corresponding to said substantially concentric annular grooves to said disk, wherein said lengthwise grooves have a smaller preselected depth than that of said circumferential grooves.

2. The method as defined in claim **1**, wherein:

said step of impressing into the disk impressions defining reference fracture locations in the form of grooves entails impressing into the disk a pattern of hexagons.

3. The method as defined in claim **1**, wherein:

said step of impressing into the disk impressions defining reference fracture locations in the form of grooves entails impressing into the disk a predetermined pattern; and

during said step of subjecting the disk to the shaping operation, converting said predetermined pattern impressed into said disk into a regular pattern of a desired fragment configuration.

4. The method as defined in claim **3**, wherein:

said step of converting said predetermined pattern impressed into said disk into said regular pattern of said desired fragment configuration entails forming, as said desired configuration, a regular pattern of regular hexagons.

5. The method as defined in claim **3**, wherein:

said step of converting said predetermined pattern impressed into said disk into said regular pattern of said desired fragment configuration entails forming, as said desired configuration, a regular pattern of substantially identical quadrangles.

6. The method as defined in claim **1**, wherein: said step of subjecting said disk to said shaping operation entails subjecting the disk to a deep drawing operation.

7. A method of producing a fragmentation jacket for a projectile comprising within the fragmentation jacket an explosive charge which is detonated by a fuze, comprising the steps of:

producing a blank in the form of a disk;

impressing into the disk impressions defining reference fracture locations in the form of grooves;

subjecting the disk to a shaping operation, thereby forming a fragmentation jacket having a predeterminate configuration;

said step of producing said blank in the form of a disk entailing the step of producing a disk comprising a central portion, an intermediate annular portion and an outer annular portion having different thicknesses relative to each other;

said step of forming said fragmentation jacket entailing the step of forming of cup-shaped fragmentation jacket having a closed nose portion, a substantially cylindrical intermediate portion of a predeterminate axial length and a fuze-receiving tale portion of different wall thicknesses which correspond to said different thicknesses of the central portion, the intermediate annular portion and the outer annular portion of said disk and which define said predeterminate configuration of said fragmentation jacket;

said step of impressing into said disk the impressions defining said reference fracture locations in the form of grooves, entailing the step of impressing, as said grooves, a predetermined pattern of grooves into one side of a preselected fraction of said intermediate annular portion of said disk;

said step of impressing said grooves into said one side of the preselected fraction of said intermediate annular portion of said disk including impressing substantially concentric annular grooves having a first preselected depth and substantially radial grooves having a second preselected depth different than said first preselected depth; and

during said step of forming said cup-shaped fragmentation jacket, converting said predetermined pattern of grooves present in said one side of said preselected fraction of the intermediate annular portion of the disk, into said reference fracture locations along a preselected fraction of said predeterminate axial length in an inner surface of said substantially cylindrical intermediate portion of said cup-shaped fragmentation jacket, and thereby producing a regular pattern of a desired fragment configuration.

8. The method as defined in claim **7**, wherein:

said step of impressing said grooves into said one side of the preselected fraction of said intermediate annular portion of said disk includes impressing substantially radial grooves having a smaller preselected depth than that of said substantially concentric annular grooves.

9. The method as defined in claim **7**, wherein:

said step of impressing said grooves into said one side of the preselected fraction of said intermediate annular portion of said disk entails impressing into the disk a pattern of hexagons.

10. The method as defined in claim **7**, wherein:

said step of producing said regular pattern of said desired fragment configuration entails forming, as said desired fragment configuration, a regular pattern of regular hexagons.

11. The method as defined in claim **7**, wherein:

said step of producing said regular pattern of said desired fragment configuration entails forming, as said desired fragment configuration, a regular pattern of substantially identical quadrangles.

12. The method as defined in claim **7**, wherein:

said step of forming said cup-shaped fragmentation jacket entails subjecting the disk to a deep drawing operation.

* * * * *